

2º CICLO EM SISTEMAS DE INFORMAÇÃO GEOGRÁFICA E ORDENAMENTO DO TERRITÓRIO

Current and future hospital locations in Vanuatu: A GIS Contribution within Vanuatu Health Policy Charlington Leo

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Contribution within Vanuatu Health Policy**

Dissertation of Master in Geographical Information Systems and Spatial Planning

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Resumo

O acesso aos serviços de saúde é um objetivo global, proporcionando à população recursos para se manter saudável e em forma. O Ministério da Saúde de Vanuatu tem o mesmo objetivo de fornecer serviços acessíveis, eficientes e acessíveis com as Infraestruturas de Saúde disponíveis como tal para Hospitais, que é o objetivo deste trabalho. Em primeiro lugar, as rotas de voo são analisadas para todas as províncias contra a localização dos Hospitais em todas as províncias de Vanuatu. A análise inclui mapas de todas as rotas domésticas semanais para Vanuatu, entre as respectivas províncias e os dois centros urbanos, Port Vila e Luganville. Foram também produzidos mapas que mostram as rotas semanais dentro de cada província.

Os mapas são então discutidos e interpretados tendo em conta a necessidade de acesso aos serviços de saúde e se as instalações de saúde estão localizadas em locais convenientes, e que se relacionam com outros serviços que as pessoas necessitam regularmente. Tendo analisado as tendências atuais dos vôos e a localização actual dos hospitais, este trabalho tentará fazer uma proposta de uma área adequada para o novo hospital no futuro, tendo como referência a Política de Saúde de Vanuatu, sobre os critérios para o estabelecimento de novas instalações que, para este trabalho, são Hospitais. Os métodos de análise espacial serão utilizados para criar mapas dos melhores locais possíveis para construir novos hospitais.

Palavras-chave: infra-estrutura de saúde, acesso, rotas de voo, política de saúde de Vanuatu, análise espacial

Abstract

Access to health services is a global aim, providing the population with resources to stay healthy and fit. Vanuatu Ministry of Health has that same goal of providing accessible, efficient and affordable services with the available Health Infrastructures as such for Hospitals which is the aim of this work. Firstly, the flight routes are analysed for all provinces against the location of Hospitals in all provinces of Vanuatu. The analysis includes maps of all weekly domestic routes for Vanuatu, between respective provinces and the two urban centres, Port Vila and Luganville. It also has maps that show the routes even within each province in a week.

The maps are then discussed and interpreted as to what the data say about access to health services and if the health facilities are located at convenient places that relate to other services that people regularly need. Having analysed the current trends of flights and the location of existing location, will further the thesis to find a suitable area for new hospital in the future with reference to the Vanuatu Health Policy on the criteria for establishment of New facilities which for this research is Hospitals. Spatial analysis methods will be used to create maps of best possible locations to build new hospitals.

Keywords: Health infrastructure, Access, Flight routes, Vanuatu Health Policy, Spatial Analysis.

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Abbreviations

AUY	Anatom Airport (Aneityum Airport)
AWD	Aniwa Airport
CCV	Craig Cove Airport
DLY	Dillon's Bay Airport
EAE	Siwo Airport
FTA	Futuna Airport
ZGU	Gaua Airport
IPA	Ipota Airport
LPM	Malekula Airport (Lamap Airport)
LNB	Lamen Bay Airport
LOD	Longana Airport
LNE	Lonorore Airport
SON	Santo-Pekoa International Airport
MWF	Maewo-Naone Airport
MTV	Mota Lava Airport
NUS	Norsup Airport
OLJ	Olpoi Airport
PBJ	Paama Airport
VLI	Bauerfield International Airport
UIQ	Quoin Hill Airport
RCL	Redcliffe Airport
SSR	Sara Airport
SLH	Vanua Lava Airport
SWJ	South West Bay Airport
TAH	Whitegrass Airport (Tanna Airport)
TGH	Tonga Airport
TOH	Torres Airport
ULB	Ulei Airport
VLS	Valesdir Airport
WLH	Walaha Airport
MoH	Ministry of Health
VNSO	Vanuatu National Statistics Office
GIS	Geographic Information System
PICs	Pacific Island Countries
NDH	Northern District Hospital
VCH	Vila Central Hospital
MDG	Millennium Development Goal

Chapter 1. Introduction

1.1 Context setting

Accessibility to health services is a primal need for all humans globally. The need to stay healthy is only solved if people access easily the services they require at the time they are in need. Status of access to health services and infrastructures are different amongst different regions worldwide. Access is easy for high and medium level countries compared to least developed countries as to which are the focus of this thesis research.

The medium that connects people and health services includes Roads, transportation (air/land and sea) and the financial means. Infrastructural services like roads, wharves and airports connects people to services like education, socio-economic activities like health as a primal service. To go to a health facility for emergency services or normal check-up for health needs, it is necessary to have access to main roads for vehicles to transport sick patients from remote areas to the nearest facilities. For areas in the suburb and rural areas, airports and wharves are necessary for transporting people to get treatment or diagnoses to get well.

The presence of the transport means through the infrastructures does not mean all groups of people access every time. Economical and financial cost of access to afford these services is paramount to determining how many manage to get services from the health facilities especially hospitals and health centres let alone the health service fee itself. All societies have they're group of status; the rich, average and poor simpler if many would like to use; employed and unemployed.it is vital to consider this area to help locate accessible but affordable health facilities to serve their purposes as to providing services to surrounding population the area accommodates and account for.

1.2 Study area

Located in the South west of Pacific Ocean is the Republic of Vanuatu, an archipelago of 83 islands divided into 6 provinces of volcanic origin situated west of the Fiji island and 123 kilometres east of Australia (Vanuatu National Statistics Office, 2015)(see figure 1). It is listed under least developed countries where services are not easily accessible to citizens though the population living near urban centres are more fortunate to access. Vanuatu have a population of 234,023 (Vanuatu National Statistics Office, 2015) with over 75percent living in the rural areas. The islands are remotely situated a chain position forming a letter Y. The proportion of population that have access to clean water sources and improved sanitation facilities is increasing (see table 1). In 2008, over 80 percent of population of Vanuatu access clean water and over 50 percent used improved sanitation facilities.

Year	Clean drinking Water sources	Improved Sanitation
1995	65	35
2000	72	41
2005	79	48
2008	83	52

Table 2: Proportion of Vanuatu population with access to clean water source and Improved sanitation 1995-2008(Indexmundi,2011)

The population of Vanuatu by sex has a close percentage though there are more males than females according to the 2009 census findings (See Chart 1).

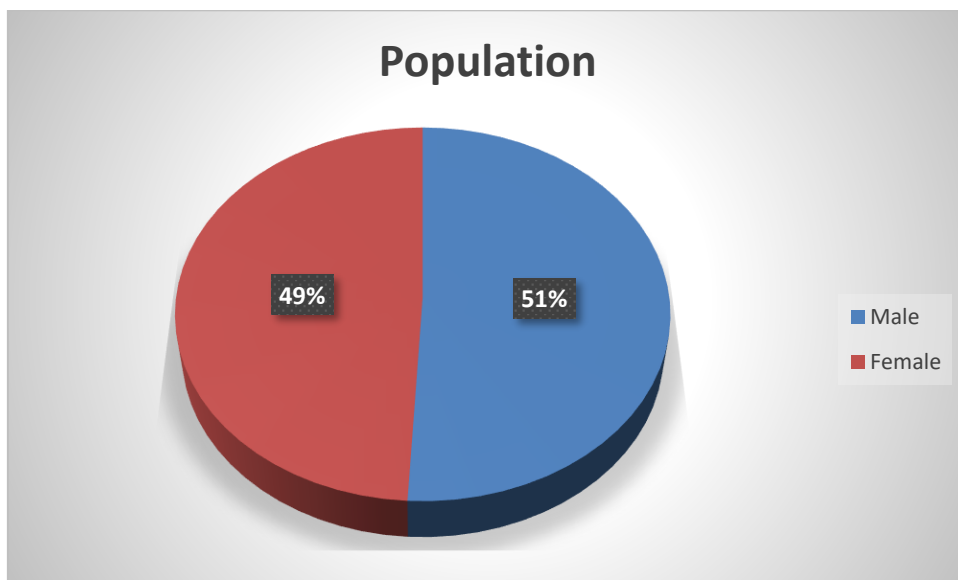


Chart 1: Population of Vanuatu by sex (VNSO,2015)

The Ministry of Health (MoH) in Vanuatu over looks all the health status, services and all health-related issues/areas of Vanuatu.it was supported by the government and other donor partners for projects and implemented programs with the ministry and all-around Vanuatu for health support in one way or the other.

According to MoH website of Vanuatu, their vision is *“to have an integrated and decentralized health system that promotes effective, efficient and equitable health services for the good health and general wellbeing for the people of Vanuatu.”* (Administrator, 2015). The decentralization came into effect in 1994 when the Vanuatu government implemented the Decentralization policy act by creating 6 provinces (Figure 1 below) with each having their own provincial running under the Vanuatu government. The MOH in response provides hospital services in five provinces most of which occupy former mission hospitals who have been demoted down to health centres in the 1990’s a decade after Vanuatu gained its independence in 1980.

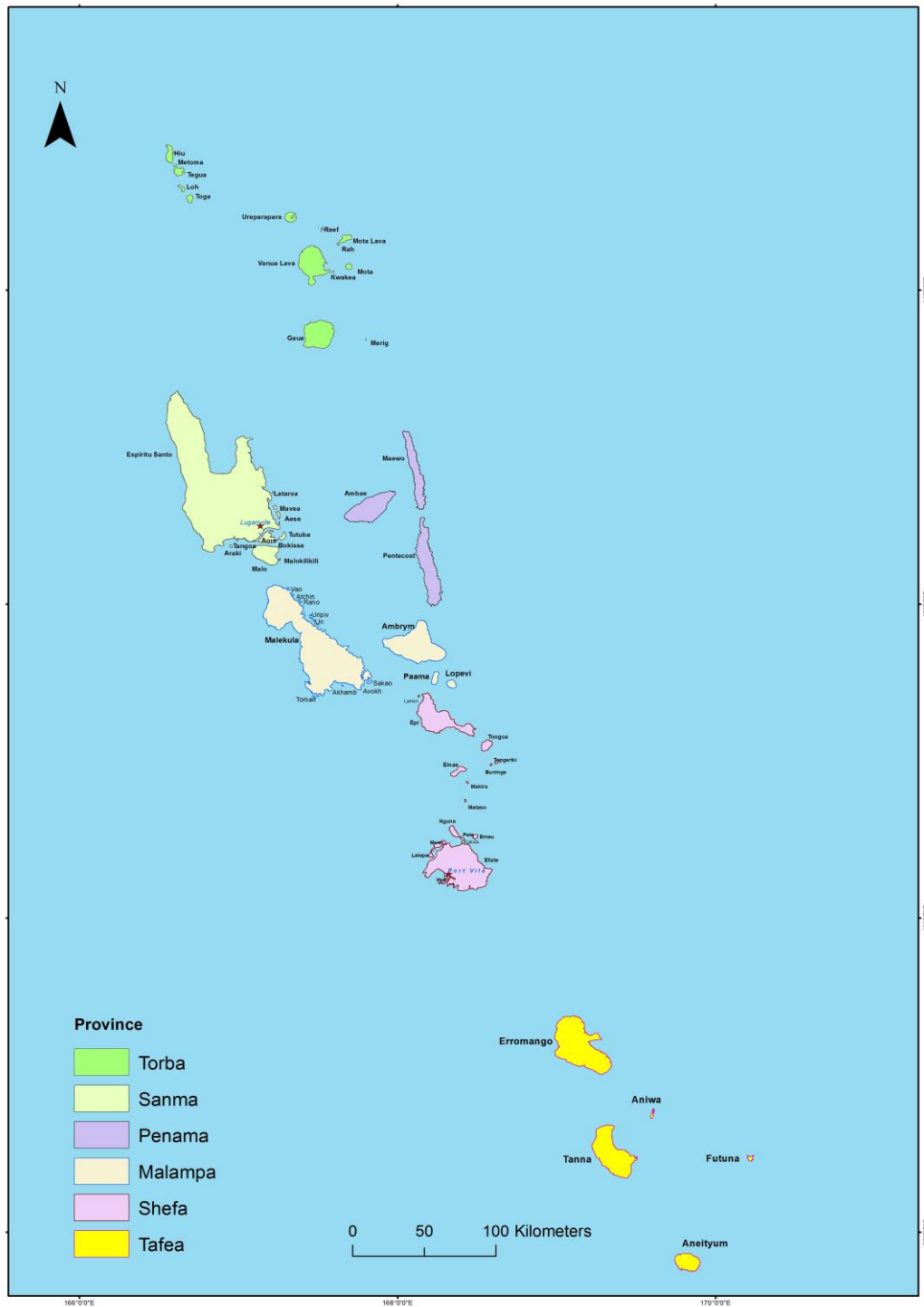


Figure 1: Vanuatu Map by provinces (Administrative boundaries: VNSO,2015)

There are two reference hospitals in the two urban centres respectively: Vila central hospital (VCH) in Port Vila, Efate island and Northern District hospital (NDH) in Luganville, Santo island. The remaining four remaining provinces have: Torba Provincial Health office in Torba, Lolowai hospital in Penama, Lamap hospital in Malampa and Lenakel hospital in Tafea province (See Table 1 below).

Name of Hospital	Province	Island	Lat.	Long.	Setting	Status
Norsup	Malampa	Malakula	16.06438 ⁻	167.39959	Rural	Open
Lolowai	Penama	Ambae	15.28029 ⁻	167.98206	Rural	Open
Northern District	Sanma	Santo	15.50870 ⁻	167.18374	Urban	Open
Vila Central	Shefa	Efate	17.73560 ⁻	168.32291	Urban	Open
Lenakel	Tafea	Tanna	19.53045 ⁻	169.2741	Rural	Open
Qaet Vaes	Torba	Vanua Lava	13.86723 ⁻	167.54117	Rural	Open

Table 3: Existing hospitals in Vanuatu (MOH,2015)

1.3 Health status

In Vanuatu, the two major diseases that are affecting the people are communicable and non-communicable diseases. Malaria and Tuberculosis (TB) are the common diseases along with Sexually Transmitted Infections (STI), HIV and AIDS. Other diseases includes; Infant Mortality, Mortality and diagnosed diseases.

1.4 Research Problem

The issue is very pressing for my country, Vanuatu. There is need for more hospitals in my country as geographically the islands remotely apart from each other. Also, some of the current locations of hospitals are hard to be accessed by people in rural areas which make up about 75% of the Vanuatu Population. These new hospitals that are needed however, must be properly located that it is fair to access by the citizens should they want to serve their real purposes.

The research topic: "***Current and future Hospital locations in Vanuatu: A GIS contribution within Vanuatu Health Policy***"

This research is based on using Geographical information system(GIS) techniques to assess current hospital locations to see the relationship between surrounding areas and their access to respective hospitals and health services available to them. Since Vanuatu is geographically composed of little islands that are remotely scattered, it is quite a challenge to plan the best locations for new hospitals. But thanks to spatial analysis techniques of GIS it helps to determine the best possible locations of new hospitals which is the aim of this research thesis. Using GIS to address health issues minimizes the effort required to solve the issue. The application of the GIS techniques of spatial analysis tools addressing the criteria's' needed will eventually produce result like possible site selections as for this research.

1.5 Aims and Objectives

The main objectives of this research are:

- To analyze the locations of current hospital locations according to the Vanuatu Health policy implemented by the Ministry of Health in Vanuatu.
 - Cartography analysis in forms of maps of domestic flights and the schedules in Vanuatu overall.
 - Spatial analysis of the access of people to the main referral hospital in Vanuatu (VCH and NDH) by airline from respective provinces.
 - Analysis of provincial flights in respective provinces with the location of provincial hospitals
- Determine best possible locations of hospitals in Vanuatu using the set criteria's in the Vanuatu health policy
 - Use spatial analysis to find suitable location of a new hospital in Shefa Province.

1.6 Thesis structure

This thesis was structured into six chapters. The initial chapter, Chapter I, introduces, sets the environment and the motivations of the research theme. It also presented an overview of Vanuatu and its health status, characteristics, Study problem which motivated me to

develop this research, its main questions and the objectives. Chapter II introduces the literature background which reviews each research themes that contextualize the dissertation: it describes and explain how research and other case studies show the relation relationships between Health systems and services relate to other variables therein. It also focuses on which areas the previous articles or literature did not cover in the aspect of this research and seeing the effectiveness of these sources to the completion of this research thesis.

Chapter III is the methodology which outlines the data sources by type either primary or secondary data sources and programs or applications use to do the analysis. It also describes the steps taken to carry out the analysis and why they are used instead of other relevant ways or techniques.

Chapter IV presents the analysis and discussion of the results obtained or derived from the steps and techniques describe Methodology. These includes tables and maps produced and created. The results are discussed and evaluated against the objectives of the research thesis. It explains what the results mean and why those results are obtain and what the results mean in the context of the health systems and hospitals established met the criteria's set out in the Health policy. Whether also if the new determined locations of new hospitals are easily accessible, efficient and will maximize the purpose of this research.

Chapter V is the conclusion that summarize the key findings and evaluation to conclude the research. It also has recommendations of some areas that future research should address as this research over-look. The recommendation also advices the policy

authorities to consider when planning for future establishments of health facilities as such for Hospitals which is the core aim of this research.

Chapter 2. Literature Review

2.1 Concept of Health system and Infrastructure

Due to the rise in demographic trends in the population and wealth, there will be more demand in infrastructure especially social and the likes. More capital should be dedicated to education and health to accommodate and keep the growing economies to be sustained. Infrastructure of roads also will connect people and households to the locations of education and health to ensure it serves its purpose to the surrounding population (PWC, 2014).

As part of sustainable development program, Disasters and climate change are affecting the health infrastructure. Low lying pacific islands are the first to suffer and the last to respond. Locations of hospitals in the low-lying areas are mostly of no planned, however, there are they because of political interests or proposed by some charitable or private companies (European Union - The Pacific Islands Forum Secretariat, Pacific Regional Indicative Programme for the period 201-2020, 2015). Their vulnerability to disasters and climate threats shows they lack factors that should have been consider beforehand like height above sea level, located with a dense population and accessible in short time so as close to main roads.

According to a brief from World Health Organization (WHO), the Pacific Island Countries(PICs) are characterized by not much population and are scattered among many remote islands with telecommunication and transport cost that are high yet with poor infrastructures (WHO, 2013). The need for better and efficiently location of hospitals to be built are the goal to cover the population to accessing the facilities and those that are standardized with recent health facilities. Population in areas in the pacific in particular Vanuatu for the case of this study has more than one-third (39%) of the population was younger than 15 years of age - youthful population, according to 2009 census (Vanuatu National Statistics Office, 2015),therefore, there is urgent need of new health facilities and hospitals as most of these youths have now reached child bearing age, especially the females. The government planning focuses on improving and building health facilities to

respond to changing epidemiological situations and such demographic trends (Archer, 2014).

2.2 Relationship between Medical supply system and Millennium Development Goals (MDGs).

The millennium development goals that are health related are a stirring aspect of accessing the health system and services provided especially in the Pacific Island countries (PICs) as for this case study the context of Vanuatu. MDGs 4 Reduce Child Mortality; MDG 5 is Improve Maternal health; MDG 6 on Combating HIV/AIDS, Malaria, and other diseases; and MDG 8 developing global partnership for development (United Nations, 2010). The Vanuatu Ministry of Health (MoH) is responsible for the distribution of medical supplies to the health facilities throughout the entire country. These facilities fall into four different groups; Hospitals, Health centres, Dispensaries and Aid post and distributed along the hierarchy pattern starting from the Central Medical Store (CMS) in Port Vila and the Division Pharmacy. The five (5) hospitals in the country both the referrals and Provincial receives medical supplies from CMS and distributes to the three lower groups of health facilities within their respective zones as more commonly refer to as their provincial zones (Vanuatu MoH, 2004). On the other hand, complicated cases of patients are referred to the elite groups going to dispensaries to health centres or hospitals directly. Therefore, they inter-relate; the supply goes down the chain to lower groups while difficult cases are referred up the higher standard facilities.

The means of how medical supplies reach the facilities either routinely and the access rate of these supplies determine or measure the achievement of the MDGs. As referred to in the research (Brown A, Gilbert B, 2012), one factor causing the lateness or regular routine of supply is the geographical locations of facilities as they are remotely scattered. The Chain of supply is hindered or untimely as transportation by land (vehicle), sea and Air is needed to complete the distribution of medical supplies. The measurement of the achievement of the MDGs depends if supplies are delivered and facilities (all groups) are fully maintained. Another challenge is the cost of delivery to the facilities. Provincial governments and hospitals are responsible for medical supply cost for delivering to their

respective facilities. Cost is a main factor slowing the distribution of medical supplies, thus, the lack of finance for provincial facilities the later the deliveries and the MDGs not met or achieved and consequences are severe.

The research on Medical supply system and MDGs is useful to this research as it allows the room for interventions to mend the relationship of health facilities, supply system and a better assessment avenue for MDGs. Unless the Health policy makers maintained the bonded relationship, they will operate as disable as they are and improvement of people's lives, effectiveness and access of good health will never be achieved.

2.3 The use of Geographic Information System (GIS) for Health Infrastructure Planning
Health planning and policy implementation has come a long way. Until the few recent years when GIS as a system has been used for managing, representing and analyse spatial data to facilitate and reduce costs in the process for selecting sites for establishment of health infrastructure (Mohammad, Ali, & Abbas, 2009). Increasing population nowadays amplifies the demand for new health facilities like hospitals. GIS is used to select optimal site for hospital construction using criteria's temporal restrictions, social restrictions not forgetting economic constraints ((Brabyn & Skelly, 2002).

According to (Brabyn & Skelly, 2002), Geographical access to New Zealand hospitals by the people are best explained and assess by GIS. GIS data layers are used to see the level or access in terms of time and distance travelled to nearby hospitals. Having figure that out they find better ways using constraints from these variables to plan effective or optimal sites to build new hospitals to ease access for the population. In the study conducted by (Mohammad, Ali, & Abbas, 2009), Another way they use GIS for health planning is the use of Accessibility Index that sees the ratio of Population density and the travel time to hospitals or health centres nearby. This implies that GIS is vital for effective planning in health especially the locations to establish new health facilities that is fair to all in terms of ease of access, same distance covered to reach the facilities.

2.4 Using GIS for Planning: Challenges

The use of GIS for planning is widely used around the globe and reduce costs and time to provide solutions relating to all the sectors particularly for health. Though the use of GIS is promising, there are challenges arising also when entire dependency on GIS. According to a review of study in Indonesia (Niel & Pat, 2003), Data limitation is main

challenge for the use of GIS for malaria research and control. This is due to lack of finance to fund the data collection and conversion paper maps as well as data to digital format to use for research and analysis of Malaria. The same applies for data for location of health facilities and other infrastructure that will aid the effective planning for new health facilities such as hospitals and health centres.

Another challenge of using GIS is lack of qualified human resources to work and use GIS. Since GIS uses new technology, there is need to train the current human resource the skills needed to work with and that goes with the cost to provide trains as well. In addition to knowledge about GIS, decision-makers do not understand its application. Therefore, the motivation to get financial support to do the work of GIS for health is not that effective. Lack of software to perform spatial analysis and its tasks are not that well understood. Moreover, these software's are controlled in powerful countries like Europe and United states (Niel & Pat, 2003). This affects how to get copies of the software's or getting support for the software should problems are encountered.

Chapter 3: Materials and Methods

3.1 DATA SOURCES:

The data used for this work was:

➤ **Census data.**

Population Data has been obtained from the Vanuatu national statistics office (VNSO) from Vanuatu. The data received is the population by province and islands so as Area councils (Administrative zones). In addition, GIS shape files of Vanuatu are provided by VNSO to create maps of Vanuatu. The shapefiles include; Contours, Islands, Coastline, Airports, Health facilities, roads.

➤ **Vanuatu airlines data**

The national Airlines of Vanuatu (Air Vanuatu) provided data on the schedule of weekly domestic flights throughout Vanuatu. The data includes the number of flights and routes between the all respective islands that have airports established on them respectively through Vanuatu. The data provided has the list of All airports in Vanuatu by island and International Air Transportation Association (IATA) code.

➤ **Vanuatu Ministry of Health**

Data for health facilities are provided by the MoH of Vanuatu and has data on health services and infrastructure and the likes. The list of all health facilities by type; Hospitals, Health centres, Dispensary and Aid posts. It has data segregated by their location and their status (Active or Not). The data received also has the role delineation (criteria's') of the establishment of new health facilities in Vanuatu. Unfortunately, it only applies to Aid posts, Dispensaries and Health centres. Advice from the Health Sector Analyst from MoH was that anything higher further than the Health Centres can be used as criteria for Hospital establishment.

3.2 GIS programs and software:

ArcGIS 10.4 software is used to make analysis and maps that is in this research thesis. It is vital program that spatial analysis and cartography maps are generated from and as for this research, it is the suitable program for GIS that best give results that are intended to be produced.

3.3 Methods and steps for Analysis:

- Firstly, create data from excel to shapefiles (Airport data). All data are there but not in the formats that can be use in ArcGIS program to create maps to analyse access to hospital facilities by air planes. The data have to be manually created and then converted as shapefiles before they can be used for analysis.
- Secondly, Create Maps for flight analysis within Vanuatu. The maps created are from all levels the National, city to provinces and within respective provinces themselves and the islands therein.
- Thirdly, using Spatial analysis techniques, the province of Shefa be analysed to find a possible location for new hospital to be built in the future. Criterias to be used are outlined by the MoH of Vanuatu and some other main common criterias normally used for location projects.

Chapter 4: Results and Discussion

4.1 Health services and access: Vanuatu global view

The geography of Vanuatu is typical and uniquely comprised of remotely located islands that stretched in a Y shape chain of Volcanic islands which makes analysis quite a challenge. GIS however ease the challenge using several types of data like administrative data and national data that is made available from the government and other private institutions. Due to the lack of some data for analysing Health services at health facilities and access, these research tries to analyse how the people of Vanuatu access health services by using Airlines (Planes) that are beyond the capabilities of Health centres, Dispensaries and Aid posts in the rural communities in Vanuatu.

The trends of domestic flights in Vanuatu originates from the two main air ports at both Urban centres in Vanuatu; Port Vila/Bauerfield on Efate island and Santo/Pekoa airport on Santo island. The routes either started from one town and ends in the other after passing through the islands on different days and different times. According to figure 2, the flight routes and number of flights makes total sense in the context of people moving to certain points or places in huge numbers. Most either move to their provincial centre to access services and in the case of this research they travel to get medical help from hospitals. Access is only possible when the medium of transportation is available to move people between their homes to services centres (PWC, 2014). For Vanuatu generally, as depicted by in figure 2 that almost all major islands have airports that allows the people to travel from islands to their provincial hospitals to receive treatment.

Torba, Penama and Malampa province are in the northern and central of Vanuatu and have flights connected to Luganville, Santo. Some people travel to Santo first before connecting to Port Vila via the flights going to Vila from Santo if Luganville is not their destination. An explanation that could be drawn from the flight routes and numbers shows the direction from provincial hospitals to NDH for sickness that could not be taken care of. Similarly, is the case for flights from Malampa, Penama and Tafea flights that connects to Port Vila on Efate. VCH is the referral for untreatable cases and sickness in the provinces, thus, the patients are flown to the Capital for treatment.

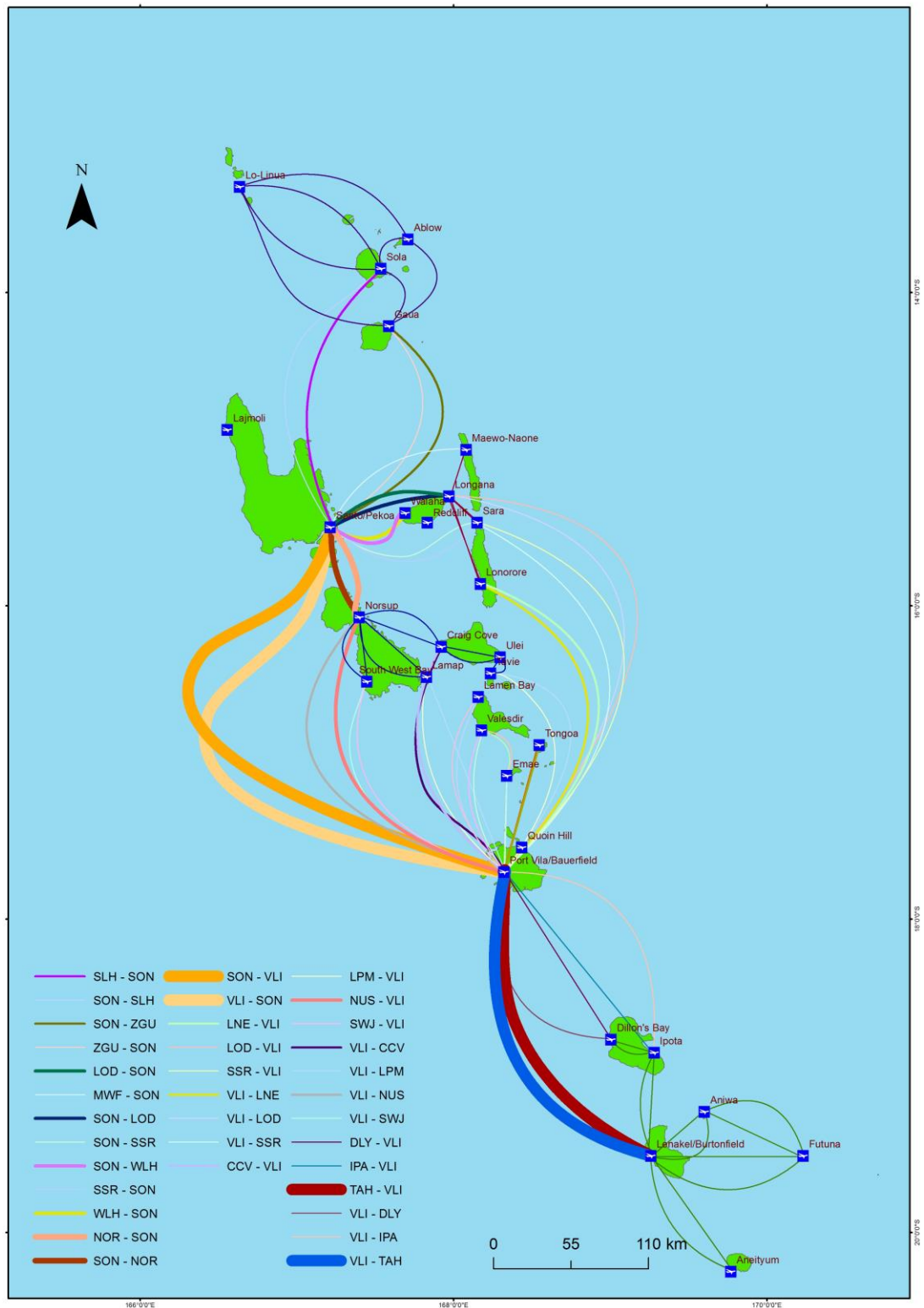


Figure 2: Vanuatu domestic weekly flights (Weekly schedules: Air Vanuatu, 2016)

4.2 The movement of people between provinces and the two referral hospitals by plane: Northern District Hospital (NDH) and Vila Central Hospital (VCH).



Figure 3: Flights between Luganville and Torba Province (Weekly schedules: Air Vanuatu, 2016)



Figure4: Flights between Santo and Malampa province (Weekly schedules: Air Vanuatu,2016)

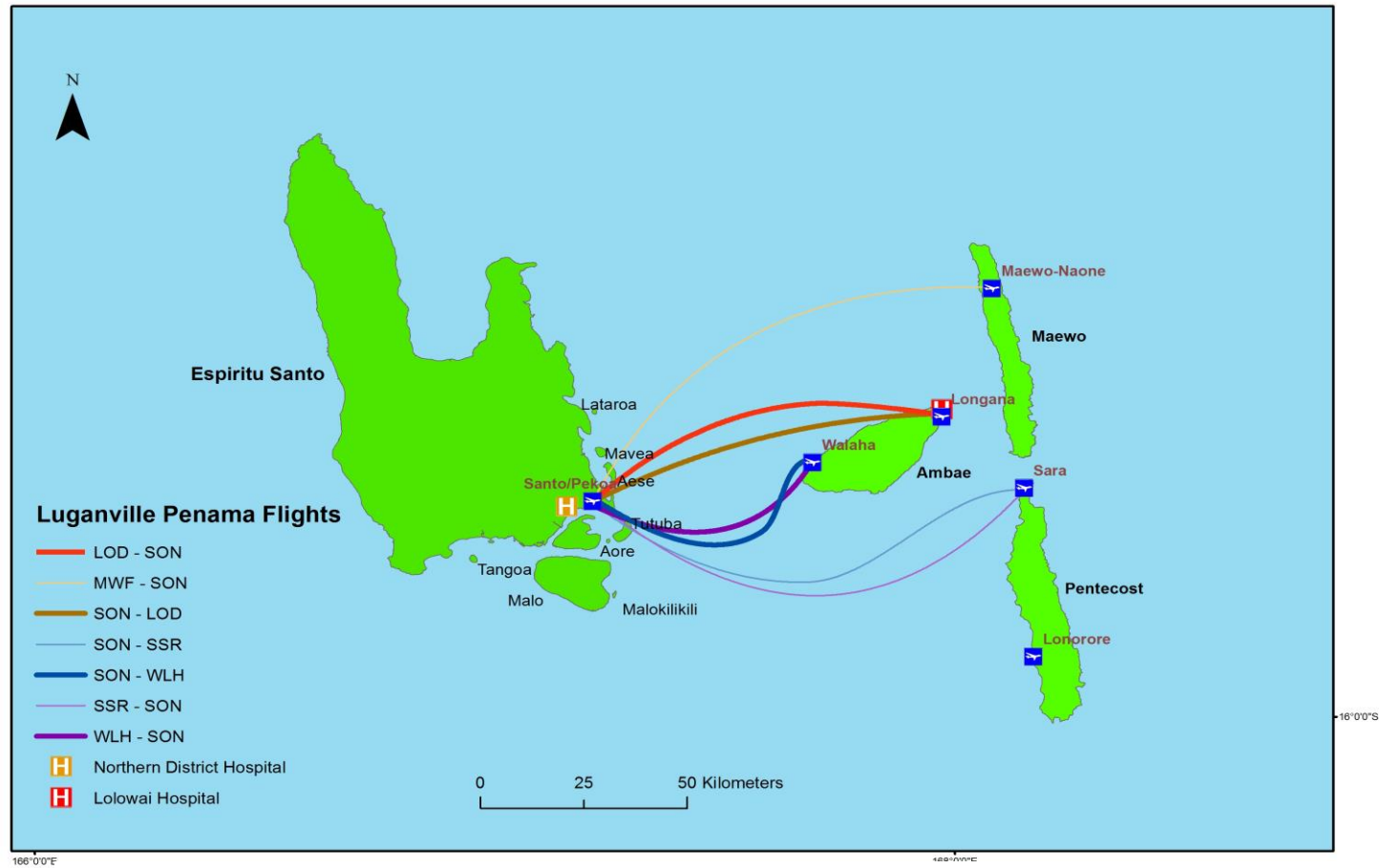


Figure5: Luganville and Penama flights (Weekly Schedules: Air Vanuatu, 2016)

Luganville, Santo receives flights from Torba, Malampa and Penama province. The flights between Torba and Santo are from Gaua and Vanua Lava (see Figure 3). Information represented on the map shows that flights from Sola Airport (SLH) to Santo-Pekoa (SON) and SON to Gaua Airport (ZGU) are many in number compare to the other two flight routes presented on the map. The thicker the flight route the higher the number of Flights per week. Therefore, health wise, those flights are of which people or sick patients are transported to Luganville for complex diseases like surgery or the likes.

Figure 4 shows the flights from Luganville to Malampa and vice versa which shows significant number of flights in both direction of the flight routes. However, there are more flights between Luganville and Malampa than with Torba. This might be due to the fact that for Malampa, the only flights to Santo is from Malekula island alone, thus all islands in Malampa province going to Santo for medical services have to connect through or fly from Norsup airport (NUS). For people who are sick and going to Santo flying from Malekula is reasonable as they may have been sent from Norsup Hospital which is also in the same area as the airport.

The flights between Penama and Luganville shows that more flights in both direction are from Ambae compared to Pentecost and Maewo island (Figure 5). Lolowai hospital is located on Ambae approximately 5 kilometres from Longana (LOD).

Figure 6 presents the flight routes down the southern side of Vanuatu especially connecting the flights to and from Port Vila-Bauerfield Airport(VLI) to Penama province. In opposition to the flights between Penama and SON, most flights are between Pentecost and VLI compare to Ambae and Maewo. As for analysis of people seeking further treatment from VCH, most are flown directly from Pentecost island while the rest from LOD whereby they might have been referred to VCH by Lolowai hospital. Also reading from the map in Figure 6, more flights both ways is higher for Lonorore (LNE) compared to the other two air ports.

Similarly, VLI has flights also from Malampa province like SON in Santo (Figure 7). NUS have more number of flights to and from VLI than other airports within the province that has direct flights to the capital. However, Malampa is the only province that

has direct flights from all airports to Port Vila-Bauerfield airport regardless of the number of flights as shown in the flight route thickness. Thus, it is easier and efficient way to transport emergency patients or regular sick people to get medical services in VCH in Port Vila.

Port Vila and Tafea flights has much more flights per week compared to all other provinces of Vanuatu. VLI and Lenakel Airport (TAH) has around 10 flights respectively each direction of the route (Figure 8). Erromango also some direct flights to Port Vila but low in number of flights. Tafea provincial hospital (Lenakel) also is in the same area as the airport (TAH). All the surrounding islands of Tafea province travel to Lenakel to access services provided by the hospitals. However, if situation gets out of hand that is when they refer them to VCH which from the analysis shown by the map would evidently meant they travel from TAH to VLI for emergencies or referral.

the flights between the two urban areas; the Capital Port Vila and the second town Luganville is as high as the number of flights between VLI and TAH in Tafea. In both towns, the location of hospitals is closed to the airports (Figure 9). Though both are regarded as referral VCH seems to be the higher standard and NDH sometimes send patients to VCH for the final decision on treatment. People travel through the two areas in search for their own plans or work yet it could be refer as also travelling to sought anything health related even if it's just regular check-up.

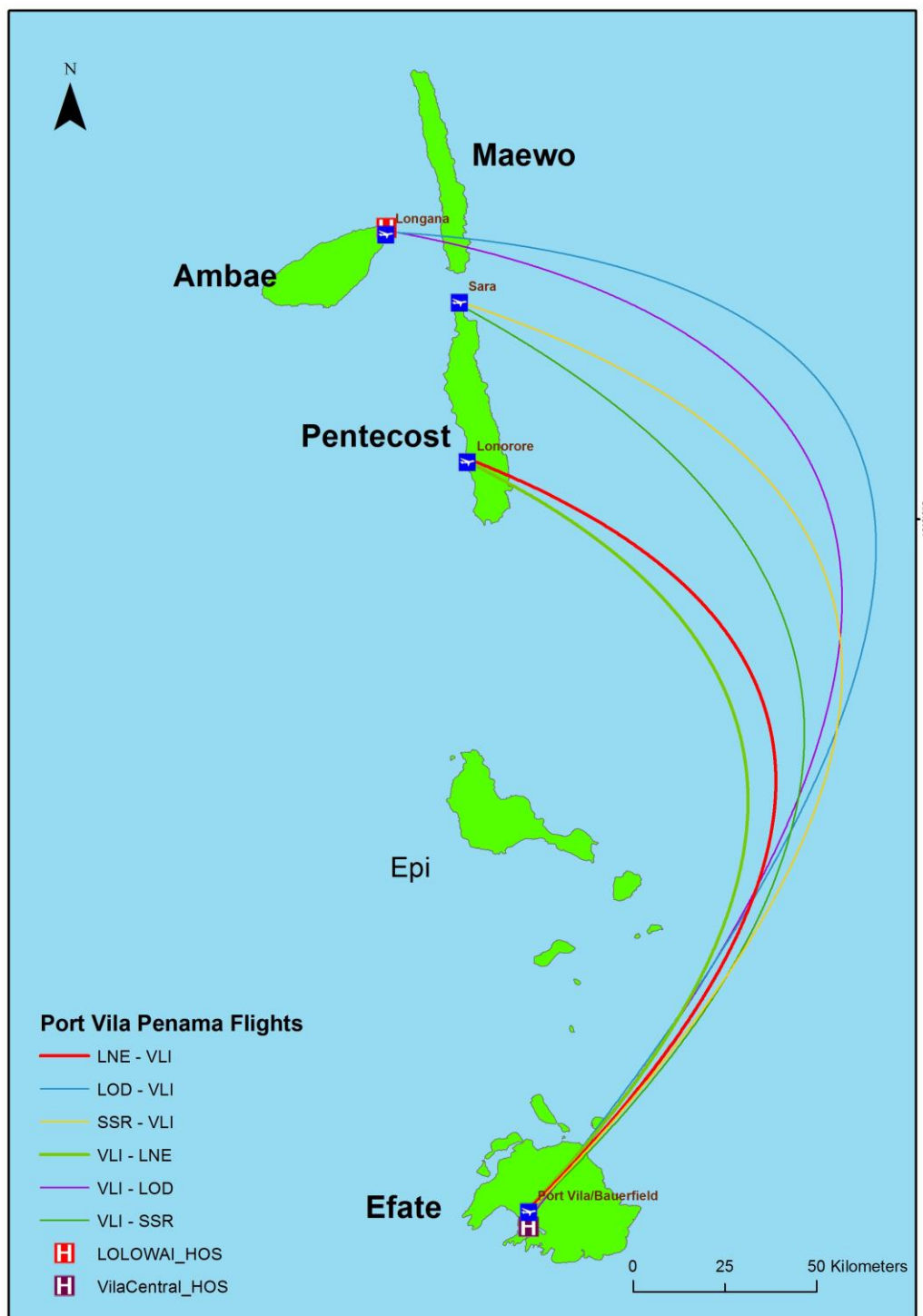


Figure 6: Port Vila and Penama flights (Weekly schedules: Air Vanuatu, 2016)

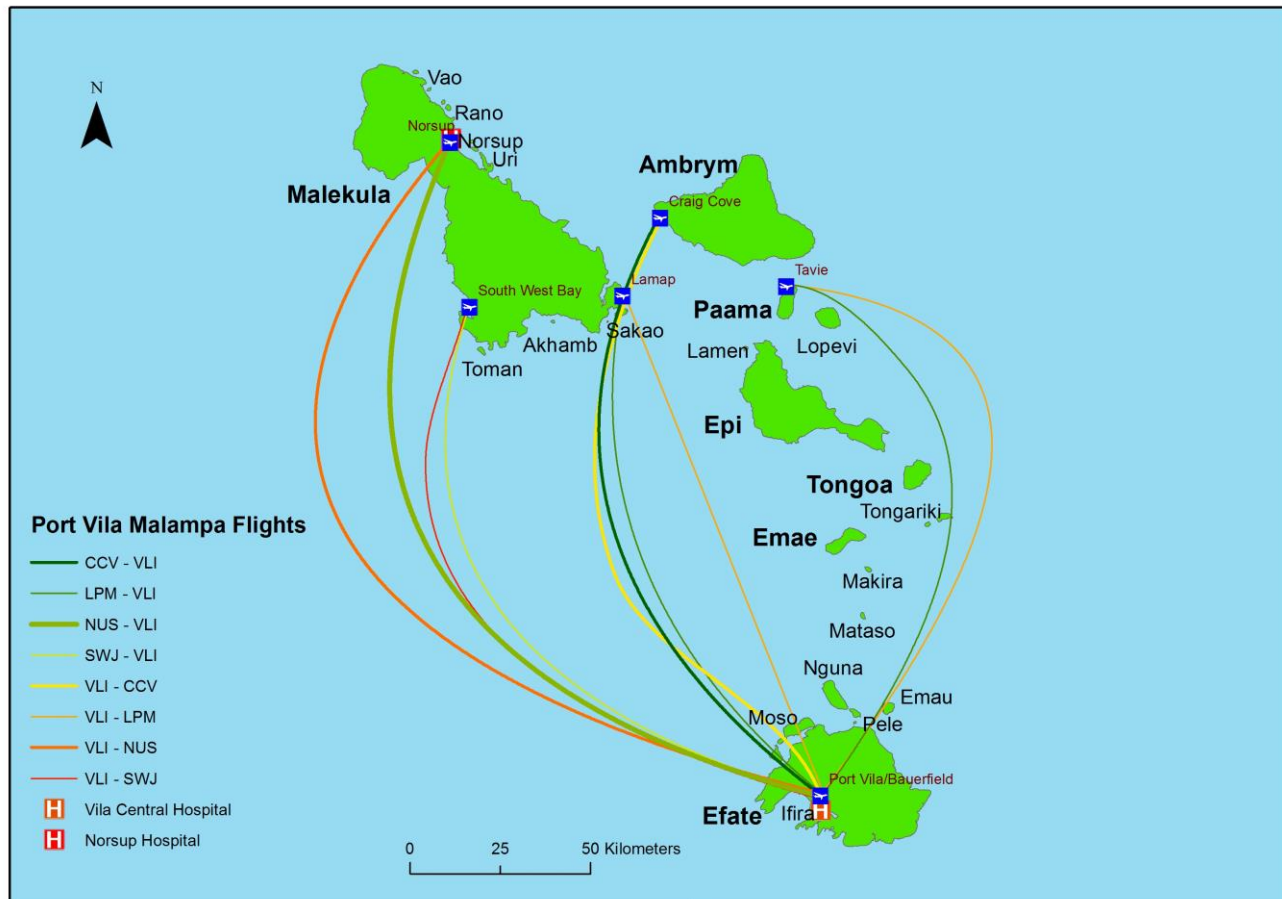


Figure 7: Port Vila and Malampa flights (Weekly schedules: Air Vanuatu, 2016)

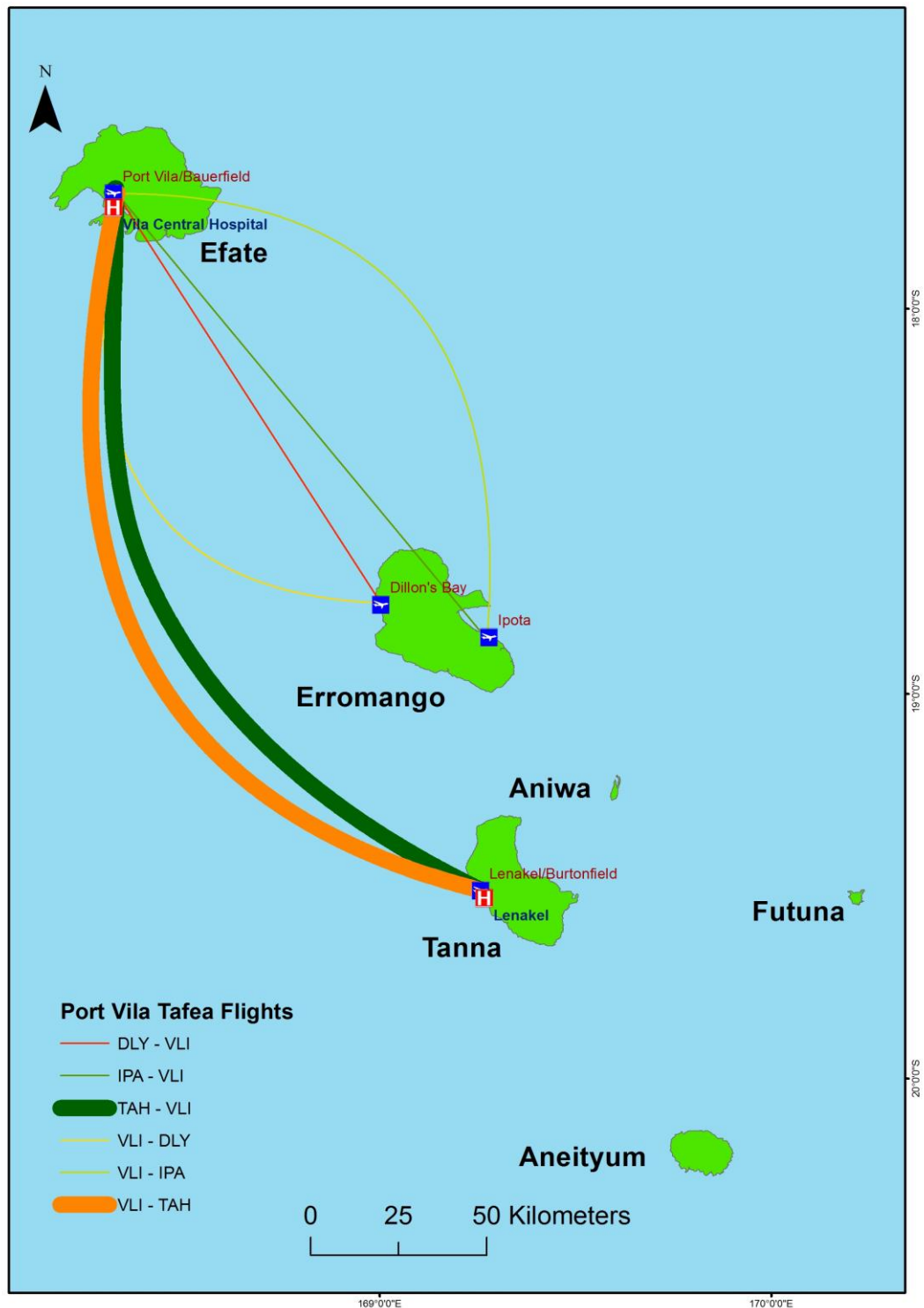


Figure 8: Port Vila and Tafea flights (Weekly schedules (Air Vanuatu, 2016))

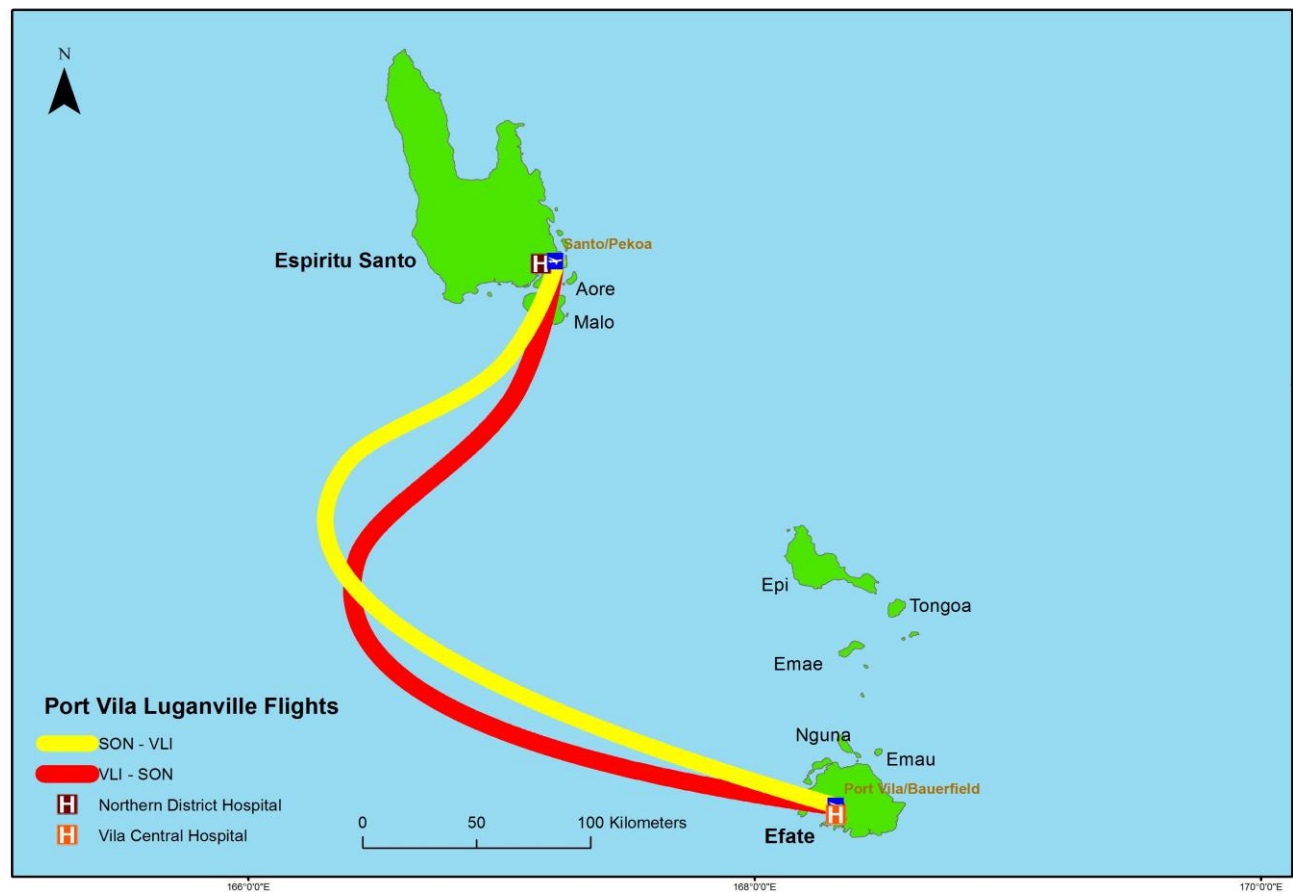


Figure 9: Port Vila and Luganville flights (Weekly Schedule: Air Vanuatu, 2016)

4.3 Flights within respective provinces to access services from their provincial hospitals.

Accessing health services at a provincial level within each province was governed by the provincial government of all provinces. They are responsible for the regular supply of medical supply and maintenance of their hospitals. Figure 10 shows the flight routes with Torba province in a week and clearly how most flights come in and out of Sola (SLH) which is the provincial Headquarter and where Qaet Vaes hospital is located.

The flights that intercepted through come from both with Banks islands and the Torres group which ideally depict that sick patients travel to Vanua Lava island to sought medical help. Figure 11 similar shows the same pattern of movement through main headquarter except this time in Penama province. All flights have the connection at LOD which is also exactly on Ambae and close to Lolowai hospital.

In addition, the flight routes within Malampa (Figure 12), Shefa (Figure 13) and Tafea Province (Figure 14) shows the same pattern of flight routes and concentrations. All the infrastructure of health and Air transportation are closely located and make access to each of the services and facilities very easy and efficient. Therefore, as a criterion for the finding suitable location, the access and closeness of areas with such infrastructure it can be said that it has met the criteria.

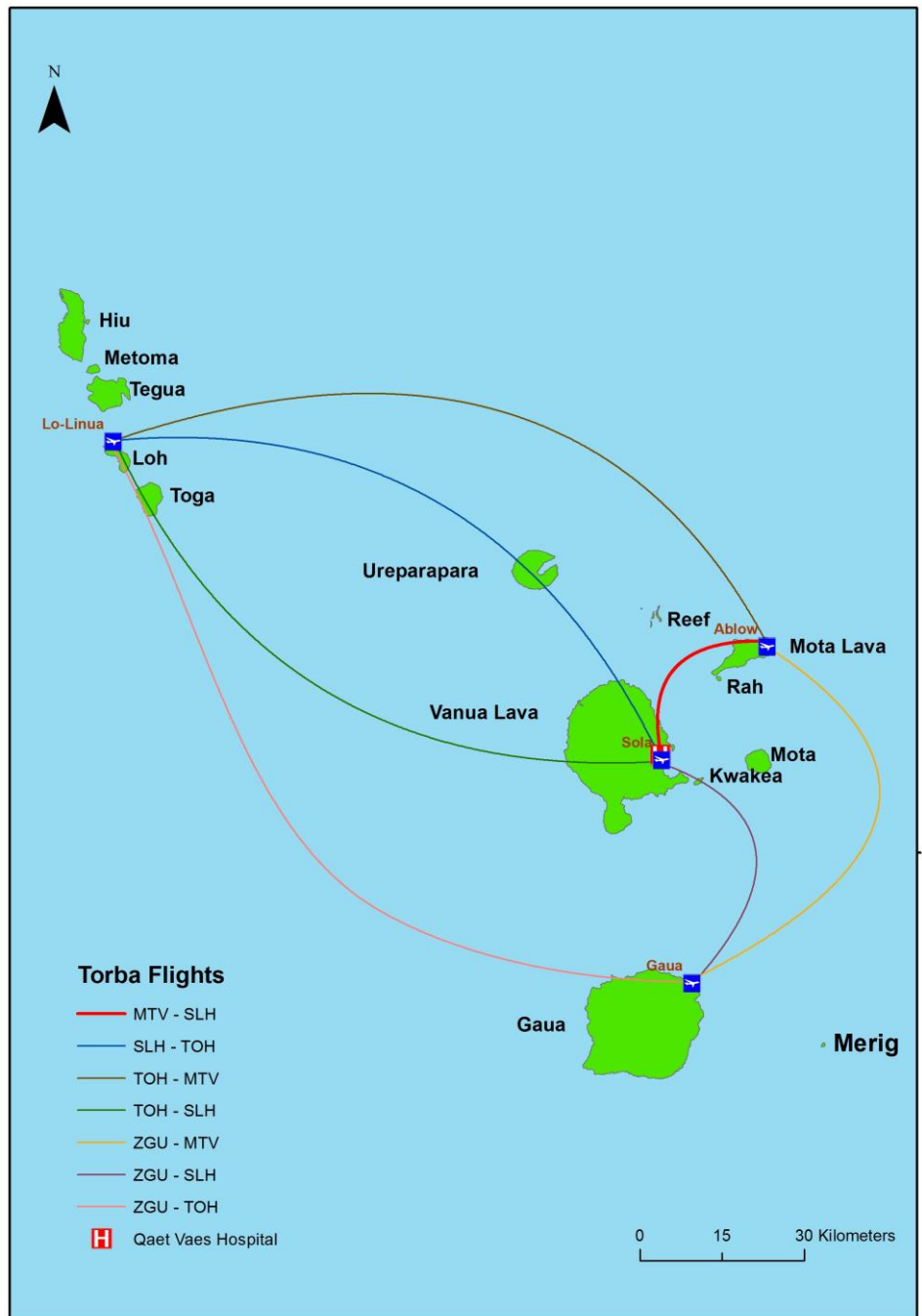


Figure 10: Torba flights (Weekly schedules: Air Vanuatu, 2016)

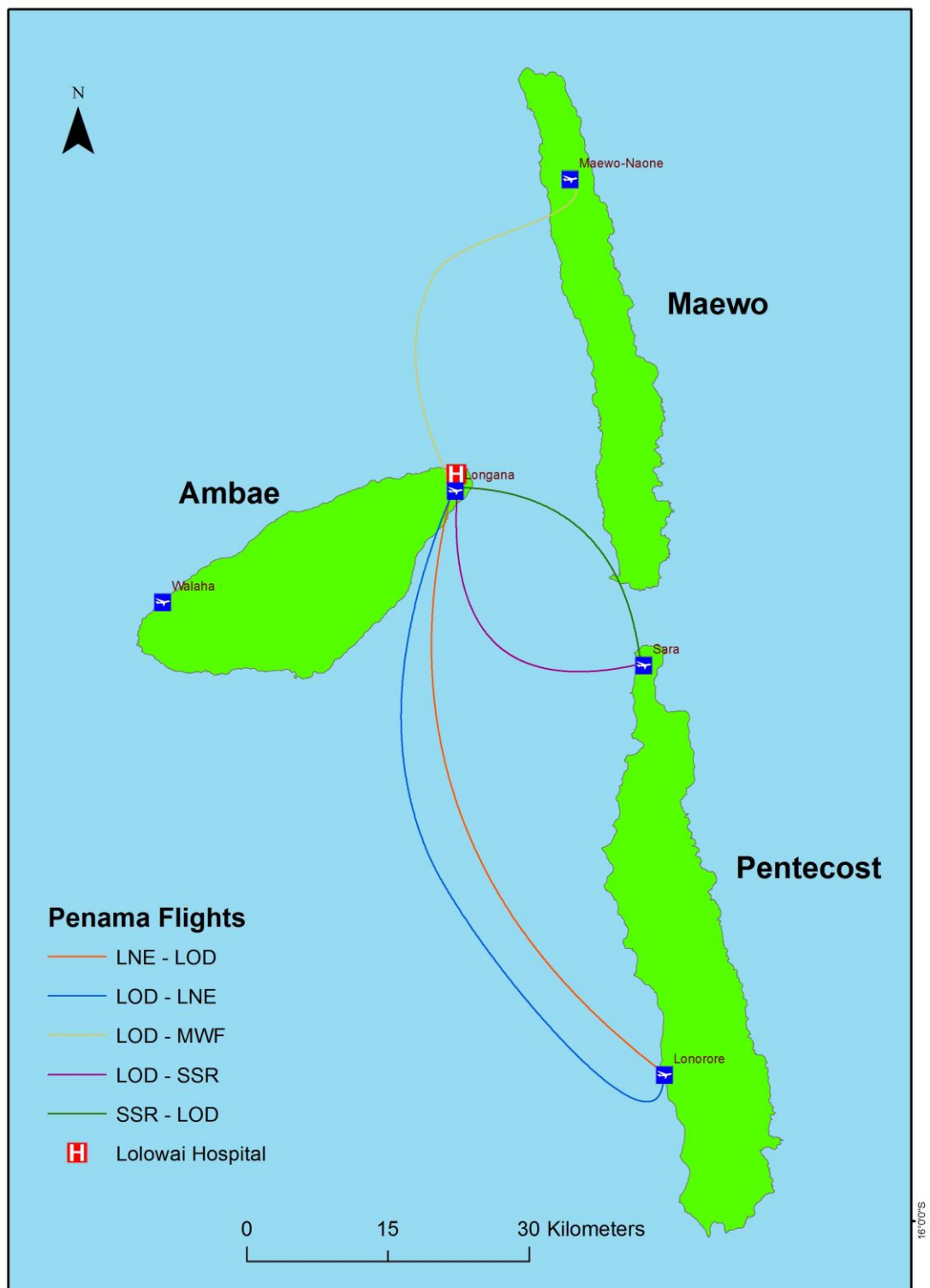


Figure 11: Penama flights (Weekly schedules: Air Vanuatu, 2016)

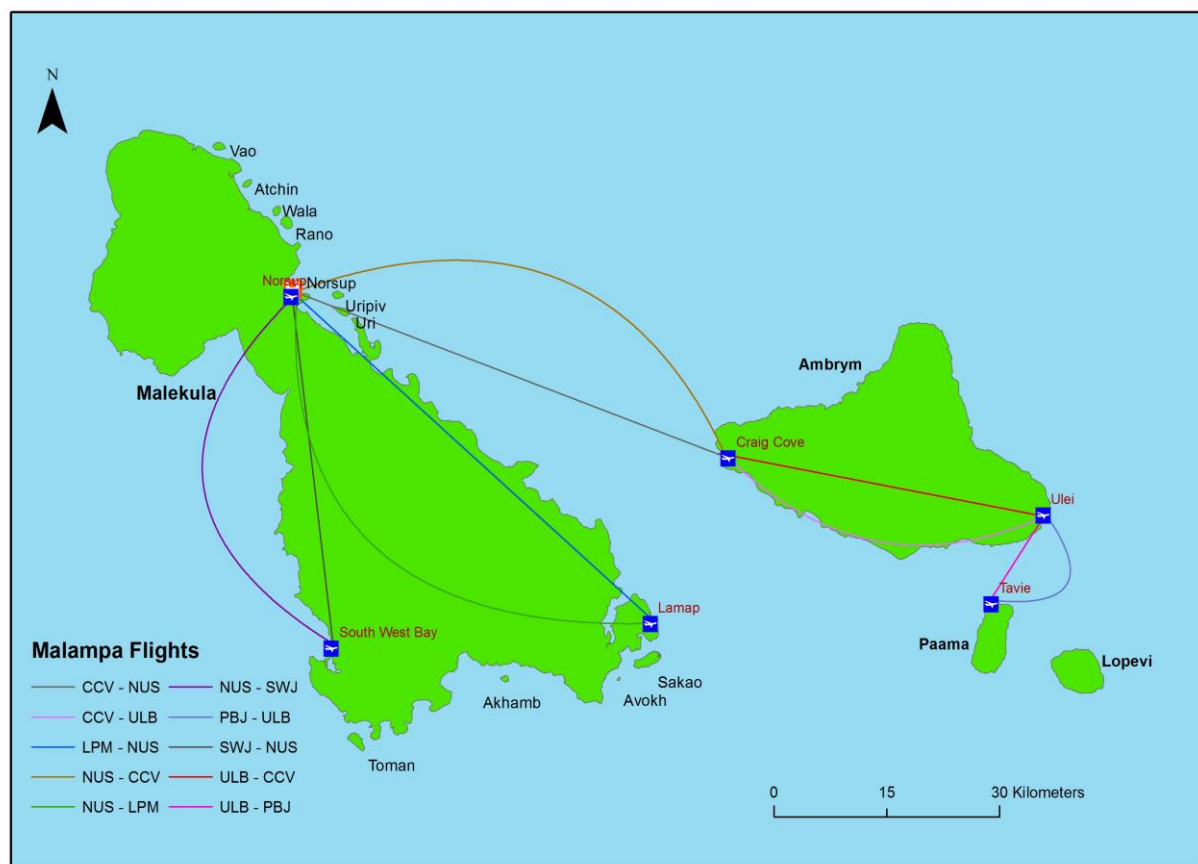


Figure 12: Malampa flights (Weekly Schedule: Air Vanuatu, 2016)

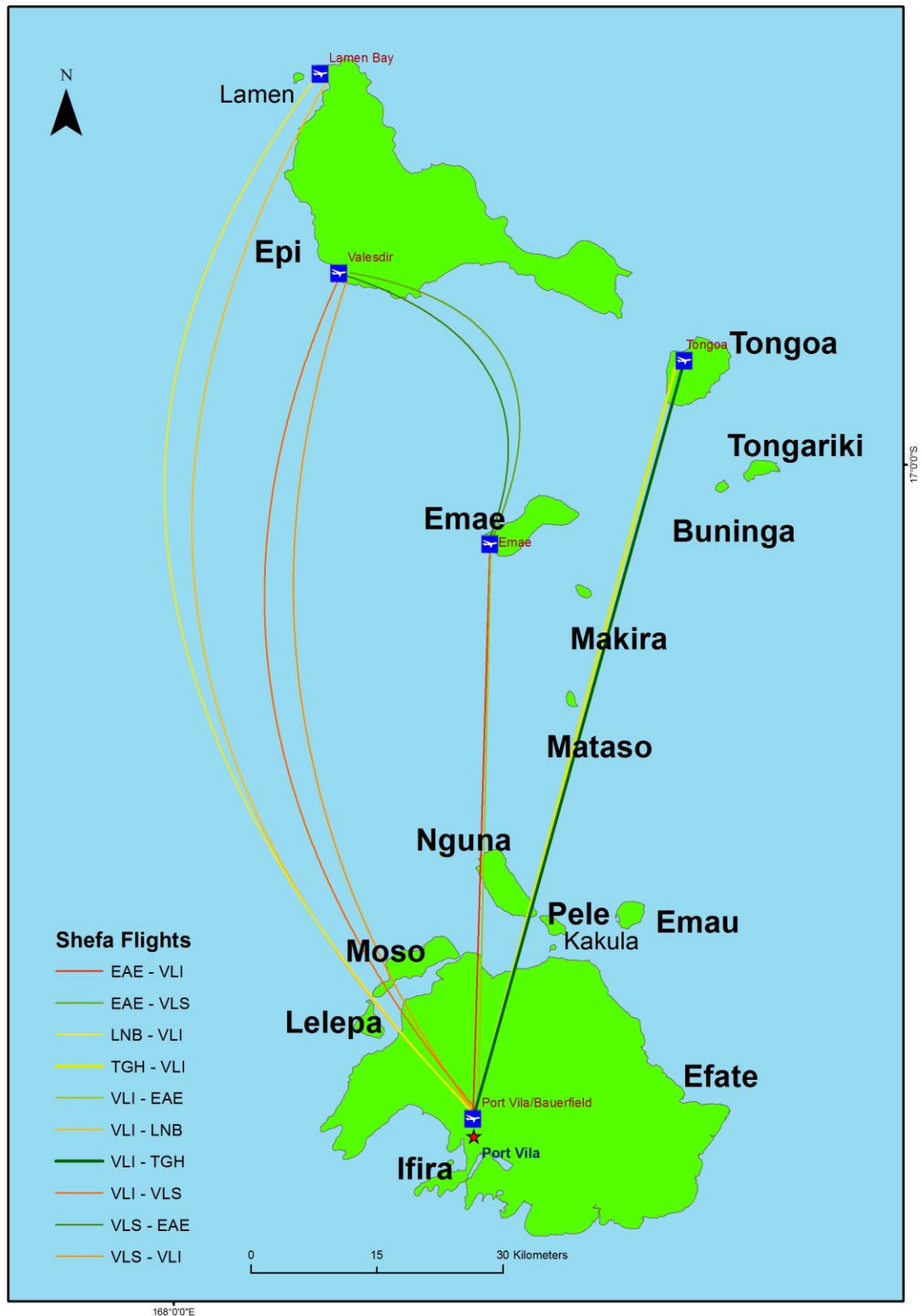


Figure 13: Shefa flights (Weekly schedules: Air Vanuatu, 2016)

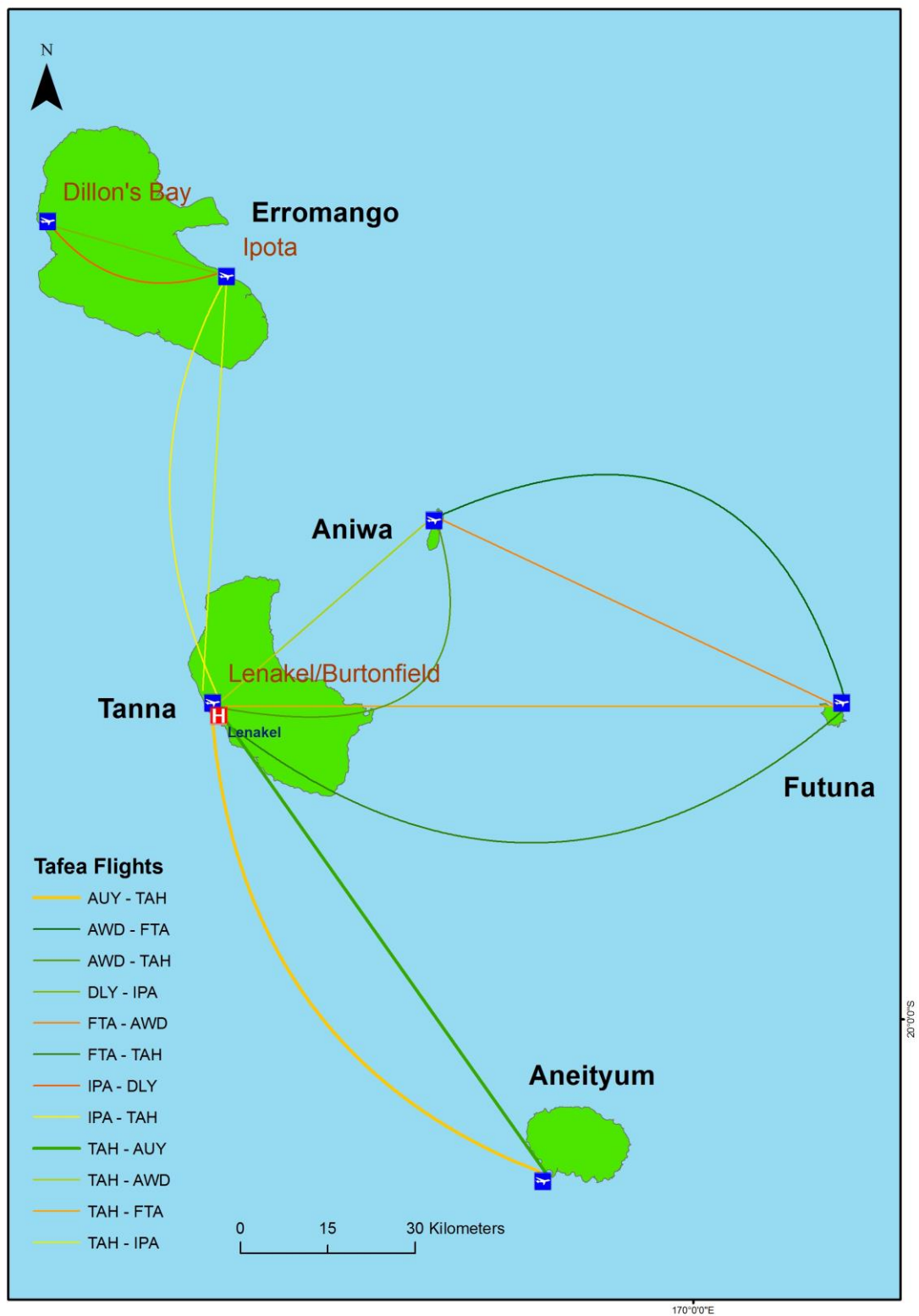


Figure 14: Tafea Flights (Weekly schedules: Air Vanuatu, 2016)

Chapter 5: Conclusion and Recommendation

5.1 Conclusion

Upon completion of this research, the objectives are quite achieved. The analysis of the current hospital locations all follow the pattern of locating near airports which makes it accessible to people and not isolated from other services that people needed daily. The schedules and flight routes per week varies from provinces and more flights are between Santo and Port Vila so as Port Vila and Tanna island.

The need of finding a best suitable area for a new hospital is a challenge especially in Shefa province as not all data needed are available but should they had been, it would ease the burden. Population is increasing and so is the need for new hospitals to be built to cater for the additional to current population.

5.2 Recommendations

To improve this research in the future here are some areas to improve:

- Make sure all administrative data are available. The government or private institutions should invest in creating data or databases to capture information of transportation by Boats with each island and the purpose of service. Also, Transport and buses on land that transport people to get medical help from health facilities.
- The government through the MoH to create new role delineation that provides the requirements of building new Health facilities.

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Anex 1

Name of Facility	Designation	Province	Island	Health Zone	Lat.	Long.	Ownership	Setting	Status
Norsup	Hospital	Malampa	Malakula	MAL01	16.06438 ⁻	167.39959	MOH	Rural	Open
Lolowai	Hospital	Penama	Ambae	PEN01	15.28029 ⁻	167.98206	MOH	Rural	Open
Northern District	Hospital	Sanma	Santo	SAN01	15.50870 ⁻	167.18374	MOH	Urban	Open
Vila Central	Hospital	Shefa	Efate	SHE01	17.73560 ⁻	168.32291	MOH	Urban	Open
Lenakel	Hospital	Tafea	Tanna	TAF01	19.53045 ⁻	169.2741	MOH	Rural	Open
Qaet Vaes	Hospital	Torba	Vanua Lava	TOR03	13.86723 ⁻	167.54117	MOH	Rural	Open

Hospital facilities and information (MoH,2016)

Anex 2

Snap shots of the table from Air Vanuatu containing the weekly flight schedule last year 2016 (Weekly schedules: Air Vanuatu, 2016)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB						
1		Flight Schedule - November 2016																											29-Jun					
2																																		
3																																		
4		MON	07-Nov-16				TUE	08-Nov-16				WED	09-Nov-16				THU	10-Nov-16				FRI	11-Nov-16				SAT	12-Nov-16				SUN		
5	737	10	VLI SYD	0700	1055	21/377 21	BNE SON	1230	1615	50 51	VLI AKL	0700	1205	50 51	VLI AKL	1645	2150	10 11	VLI SYD	0700	1055	50 51	VLI AKL	0700	1205	10 11	VLI SYD	0700						
6		11	SYD VLI	1155	1510		SON VLI	1700	1730		AKL VLI	1305	1420		AKL VLI	1305	1420		SYD VLI	1155														
7		20	VLI-SON	1610	1645		20/378	SON-BNE	1730		1940	10	VLI SYD		1520	1915	20		VLI BNE	1610	1810		10	VLI SYD	1520		1915	20	VLI BNE	1610	1810	10	VLI SYD	1520
8		20/378	SON-BNE	1730	1940			11	SYD VLI		2015	2330	21		SYD VLI	2015	2330		21	BNE VLI	1910		2240	11	SYD VLI		2015	2330	11	SYD VLI	2015	2330	11	SYD VLI
9																																		
10	ATR	AV72																																
11		210	VLI SON	0730	0820	240	VLI TAH	0700	0740	64	VLI NOU	0630	0805	240	VLI TAH	0700	0740	64	VLI NOU	0630	0805	210	VLI SON	0730	0820	210	VLI SON	0730						
12		211	SON VLI	0855	0945	241	TAH VLI	0820	0900	65	NOU VLI	0845	1020	241	TAH VLI	0820	0900	65	NOU VLI	0845	1020	211	SON VLI	0900	0950	211	SON VLI	0855						
13		240	VLI TAH	1020	1100	210	VLI SON	0940	1030	210	VLI SON	1120	1210	210	VLI SON	0940	1030	208	VLI SON	1615	1705	74	VLI NAN	1100	1515	240	VLI TAH	1020						
14		241	TAH VLI	1140	1220	211	SON VLI	1110	1200	211	SON VLI	1250	1340	211	SON VLI	1110	1200	209	SON VLI	1745	1835	75	NAN VLI	1600	1615	241	TAH VLI	1140						
15		208	VLI SON	1255	1345	238	VLI TAH	1430	1510	238	VLI TAH	1520	1600	238	VLI TAH	1430	1510					208	VLI SON	1715	1805	208	VLI SON	1255						
16		209	SON VLI	1425	1515	239	TAH VLI	1550	1630	239	TAH VLI	1640	1720	239	TAH VLI	1550	1630					209	SON VLI	1845	1935	209	SON VLI	1425						
17																																		
18																																		
19																																		
20																																		
21			64	VLI NOU	1615	1750					208	VLI SON	1800	1850												64	VLI NOU	1615						
22		65	NOU VLI	1830	2005					209	SON VLI	1930	2020												65	NOU VLI	1830							
23																																		
24		AV11				AV11				AV11				AV11				AV11				AV11				AV11								
25		212	VLI-LPM	0700	0745	242	VLI-DLY	0900	0940	222	VLI-SSR	1000	1110	212	VLI-SWJ	0830	0915	210	VLI SON	0700	0810	212	VLI-NUS	0700	0800	230	VLI-PBJ	0700						
26			LPM-NUS	0755	0820		DLY-IPA	0950	1005		SSR-LOD	1120	1135		SWJ-NUS	0925	0945	211	SON VLI	0840	0950		NUS-SON	0810	0835		PBJ-ULB	0750						
27			NUS-SON	0830	0855		IPA-TAH	1015	1035		LOD-SON	1145	1215		NUS-SON	0955	1020										ULB-CCV	0815						
28																		232	VLI LNB	1020	1100	266	SON-SLH	0935	1025		CCV-NUS	0840						
29		266	SON-ZGU	0925	1005	256	TAH-AWD	1105	1125	228	SON-WLH	1315	1340	1226	SON-LOD	1050	1120	233	LNB VLI	1110	1150		SLH-TOH	1040	1110		NUS-SON	0910						
30			ZGU-TOH	1020	1100	257	AWD-FTA	1135	1200	229	WLH-SON	1350	1415		LOD-MWF	1130	1140					267	TOH-SLH	1120	1150									

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD		
Flight Schedule - November 2016																												*****			

Snap shot of the page with Role delineation of Health facilities from the Vanuatu Health policy (2004).

ROLE DELINEATION FOR PROVINCIAL HEALTH FACILITIES (May 2004)					
Level	Population	Travel	Services	Skills	Resources
Health Centre Level 3a	2000 - 3000 or OPV's >300/mth	80% pop within 4hr; Remote (i.e.refer by air)	As for Level 2a plus: <u>Acute</u> : Inpatients with access to overnight staffing; Higher risk deliveries; Minor surgery including POP; Dental care	Nurse Practitioner <u>and</u> Midwife <u>and</u> Staff Nurse + Aid Nurse and others when fully supported by Community 3 MOH Staff	As for Level 2a plus; Separate consultation and treatment areas; 2-bed general and 2-bed female wards; Locked room or shed for storage for Zone e.g. nets, insecticide, excess supply Transport for supervisory visits and outreach Malaria Lab;
	2500 - 5000 or OPV's > 300/mth	80% pop within 4hr; Not remote			
Health Centre Level 3b	1000 - 2000	80% pop within 4hr; Remote (i.e.refer by air)	<u>Primary</u> : Visiting teams e.g.cyc, medical	Nurse Practitioner <u>or</u> Midwife <u>plus</u> Staff Nurse +Aid Nurse supported by community 2 MOH Staff	
	2000 - 2500 & OPV's <200/mth	80% pop within 4hr; Not remote	<u>Supervisory role</u> for other MoH facilities		
Dispensary Level 2a Remote	300 - 1000	80% pop within 1hr; Remote (i.e.refer by air)	As for Level 2b plus; <u>Acute</u> Some higher-risk deliveries; Admissions <u>Primary</u> : RH-IUD insertion	Midwife Extra training + Aid Nurse supported by Community 1 MOH Staff	As for Level 2b plus; Vaccine fridge
Dispensary Level 2b	300 - 2000	80% pop within 1hr; Not remote	<u>Acute</u> : Normal deliveries; Minor suturing; Stabilise and refer <u>Primary</u> : Immunisations, RH, MCH <u>Public</u> : as for Level one <u>Supervisory role</u> for VHWS and TBAs	Staff Nurse + Aid Nurse supported by Community 1 MOH Staff	Secure communications (e.g. Public Phone or Clinic Tele-radio); Solar, generator or community power supply; Lighting to delivery & treatment areas; Steriliser (use cooking fire); Water supply (multi-rain tank/ community supply); Water seal toilet and soakaway/septic; Secure area for medical waste and disposal Consultation/ treatment area with secure drugs storage; Delivery & 2-bed Maternity ward; Patient shower / washroom; Covered waiting area
	2000 - 4000	80% pop within 1hr; Also 1hr from Hospital or Health Centre			
Aid Post Level 1	100 - 300	80% pop within 30 mins	<u>Acute</u> : Basic treatment; Counsel and refer <u>Primary</u> : Information, condom distribution, assists with mobilisation for EPI, mass treatments etc. <u>Public</u> : Sanitation, bed nets <u>Supervisory role</u> for community based	Aid Nurse supported by Community	Drugs and basic supplies from MoH Water source nearby Building from Community

